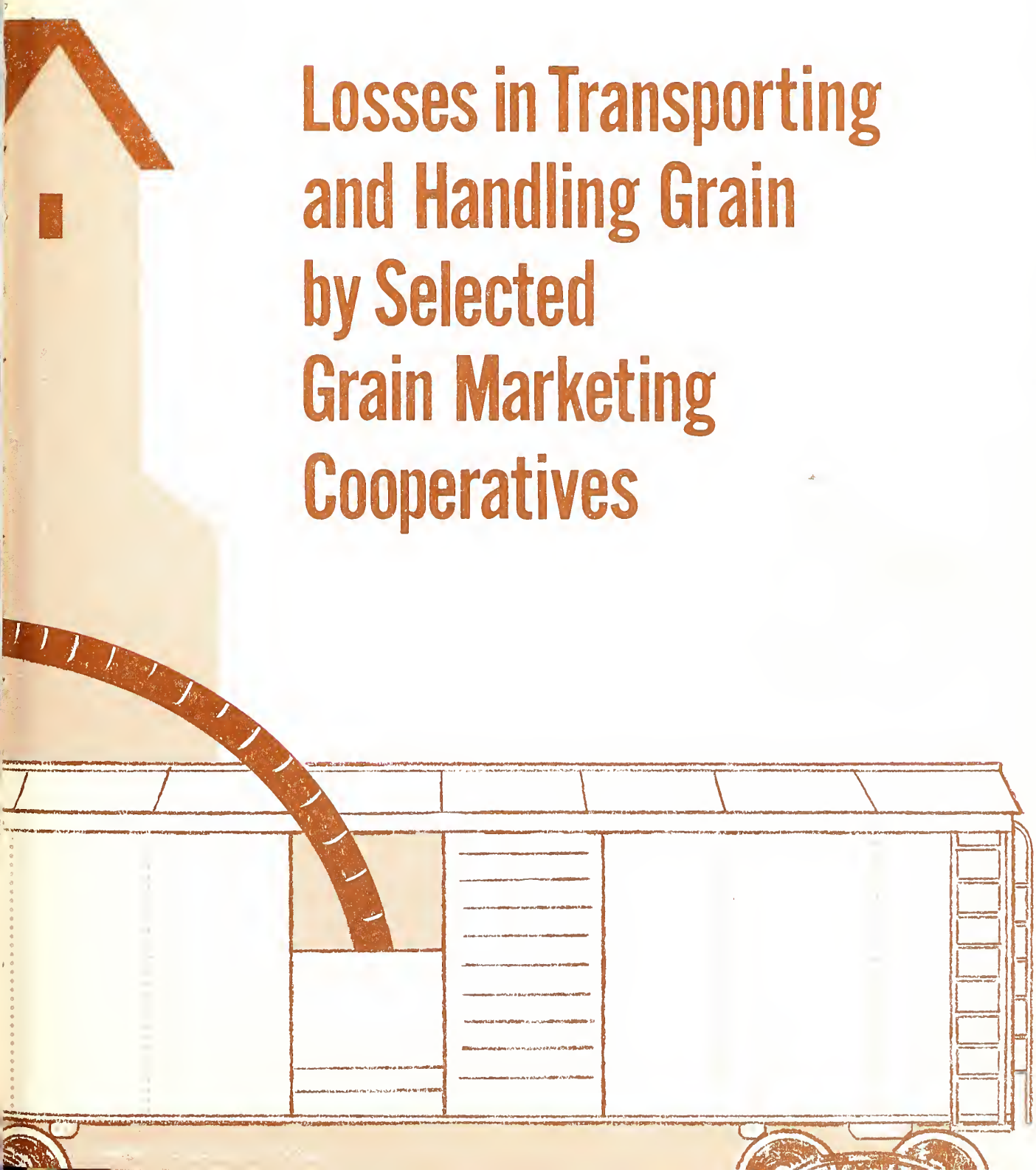
FARMER COOPERATIVE SERVICE • U.S. DEPARTMENT OF AGRICULTURE • MARKETING RESEARCH REPORT NO. 766

Losses in Transporting and Handling Grain by Selected Grain Marketing Cooperatives



FARMER COOPERATIVE SERVICE
U.S. DEPARTMENT OF AGRICULTURE
WASHINGTON, D.C. 20250

The Farmer Cooperative Service conducts research studies and service activities of assistance to farmers in connection with cooperatives engaged in marketing farm products, purchasing farm supplies, and supplying business services. The work of the Service relates to problems of management, organization, policies, financing, merchandising, product quality, costs, efficiency, and membership.

The Service publishes the results of such studies; confers and advises with officials of farmer cooperatives; and works with educational agencies, cooperatives, and others in the dissemination of information relating to cooperative principles and practices.

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AUGUST 1966

SUMMARY

Loss and damage to grain during handling and transportation is a serious economic problem to farmers and their grain marketing cooperatives. Farmer Cooperative Service conducted this study of losses in handling and transporting grain by rail and barge, with particular emphasis on shortage of weight at destination, in order to explore the economic significance of the losses, to identify possible causal relationships, and to suggest ways to control or eliminate the losses.

Six regional grain marketing cooperatives in the Midwest cooperated in the study. These regionals supplied data on shipments made over a period of up to 3 years from 107 local elevators affiliated with one or more of them. A total of 13,611 individual rail shipments were studied, amounting to over 35 percent of all rail shipments made by these elevators during the period covered. The sampling rate on shipments at individual elevators ranged from 10 percent to 100 percent, depending on shipping volume. Seven hundred railroad box cars which had been offered the participating elevators for loading were also inspected to determine their physical condition.

Based on differences between origin and destination weights, the study shows the loss was 558 pounds per car if the total loss is distributed over all 13,611 cars shipped, or 923 pounds per car if the total loss is distributed over the 8,231 cars which were short.

Shippers can recover some of this loss if they file properly substantiated claims with the carrier according to ICC rules and regulations. Claims can be filed by the shipper himself or through an agent. The regional cooperatives included in this study offer a claim service without charge to their local elevator members. Very few of the local elevators were making use of this service. The majority that filed claims were using independent agents or claim bureaus to whom they paid from 25 percent to 35 percent of the recovered amount as a service fee. Altogether, only 48 percent of the locals ever filed claims. Many of these did so only intermittently and then usually on cars with particularly high losses.

Every local elevator studied had cars short at destination. The number short varied from 5 percent to 93 percent of the cars studied. The number of cars shipped during a given period did not seem to be closely related to loss, since the loss rate did not increase measurably as the number of cars shipped increased.

An analysis of the various weighing and loading methods showed 10- and 25-bushel automatic hopper scales were used by about 60 percent of the participating elevators. In a few cases where nonautomatic hoppers were used, the loss was considerably higher.

The sample shipments studied originated in six States and terminated in 25 States. There were 50 different combinations of origins and destinations. About two-thirds of the shipments were intrastate movements. Shipments that moved over 1,000 miles averaged much higher losses than those under 1,000 miles. This record indicates that length of haul is a factor in losses, particularly in corn shipments.

Nine railroads served the 107 elevators studied. Five of these lines accounted for 90 percent of the elevators studied and 91 percent of the sample shipments. For the five principal carriers, cars short at destination ranged from 57 to 66 percent of the total sample cars originated. Because of the influence of other factors, it is difficult to associate losses with the carrier as such, but the figures do

indicate that some carriers do a better job than others--perhaps by furnishing better cars.

Cars of 94 different railroads were included in the sample; 62 percent of these were "foreign" cars insofar as the particular shipment was concerned. An analysis of short cars on the basis of whether they were foreign or on-line relative to the originating carrier failed to develop any positive loss correlation.

Shippers complained that most of the grain shortages at destination were due to defective cars furnished by the carrier. Inspection by the researchers of 700 cars furnished to elevators cooperating in the study showed that only 15 percent were sound and free from loss-associated defects. When a car is defective, the shipper has three alternatives: He can reject the car, he can make repairs himself, or he can go ahead and use the car as it stands.

Generally, the shipper will make minor repairs such as patching small holes or stopping up cracks. If he has the time, he may repair or replace battered doorposts. Limited information obtained during the study indicated that shippers spent an average of about 60 cents per car for labor when they made repairs themselves and an average of about 40 cents per car for cleaning.

The greatest number of defects were found in the car sidewalls, with battered or missing doorposts being the major defect. Approximately 52 percent of the inspected cars had defects in more than one component part of the car--floor, sidewalls, ends, and roof. Shippers repairing cars themselves reported that repairs were made at more than one location within the car in 24 percent of the instances. This same percentage prevailed, in a quarter of the total cars rejected when two or more reasons were given for rejection.

To investigate loss and damage by barge, 777 barge shipments of 31 million bushels of grain marketed by the cooperatives were studied, with losses determined by comparison of weights at origin and destination. In addition, observations were made of the condition of the barges before and after loading, facilities used at terminals, and loading, towing, and discharging operations.

The only tangible record of loss and damage was found in a comparison of the origin and destination weights on each barge. Shippers are not compensated for losses or shortages between origin and destination weights by the barge lines.

Wheat movements showed the lowest loss, with approximately one-fourth of 1 percent of total origin weight involved. Corn and oats had a somewhat higher loss, approximating one-third of 1 percent of origin weight, whereas the movement of soybeans showed the highest percentage--approximately one-half of 1 percent. For all movements, the loss was about one-third of 1 percent of origin weight.

No specific patterns of losses were revealed when comparisons were made by commodity, by river, or by port. Average loads carried by barges in this study amounted to 34,180 bushels for wheat, 43,342 bushels for corn, 39,971 bushels for soybeans, and 44,433 bushels for oats. Losses per bargeload were 137 bushels for oats, 77 bushels for wheat, 137 bushels for corn, and 218 bushels for soybeans.

No damage was reported as a result of insect infestation or storage fungi. Changes in grade did occur as a result of high moisture content of grain.

Findings of the study highlight the importance of individual management practices in controlling losses. There are enough exceptions to the general findings about each type of loss studied to demonstrate that the various loss-associated conditions and practices need not be loss contributing. Any shipper, by faithfully fulfilling his obligations as a shipper and exercising care during all operations incident to handling and transportation, can help overcome the various impediments to loss-free transportation. This further enables the shipper to demand that carriers meet their responsibilities as well.

LOSSES IN TRANSPORTING AND HANDLING GRAIN BY SELECTED GRAIN MARKETING COOPERATIVES

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Loss and damage to products during handling and transportation are problems that have plagued shipper and carrier alike through the years. This is especially true when shipments involve perishable or fragile commodities. While there have been efforts on the part of all concerned to eliminate or reduce losses, the degree of success has varied among commodities. Because such losses are substantial in grain transportation and reduce income of farmer-producers who are members of grain marketing cooperatives, Farmer Cooperative Service conducted this study to determine the extent of losses, their economic significance, and their relationship to various transportation and handling factors.

Grain loss and damage in transit may occur from insect infestation in equipment being used to handle and transport grain; by grain going "out of condition" because of defective equipment or other adverse conditions during transit; and by contamination of grain loaded into equipment which has not been properly cleaned.

[1] Mr. Rickenbacker is no longer with the Farmer Cooperative Service.

The most prevalent grain loss problem is leakage during transportation or handling. It is true there may be inaccuracies in weighing equipment and shrinkage that would account for some reduction in weight, but often the net loss in weight is due to grain leaking out of the transportation equipment. While a great deal of research has been done--and is yet being done--on the problems related to infestation, shrinkage, and other problems largely concerned with the physical characteristics of the grain itself, little has been done on the problem of shipments being "short at destination."

We recognize that many cars or barges arrive at destination with no change in weight or are over weight upon arrival. However, the basic purpose of this study was to determine the loss that a shipper of grain might incur during transportation and handling. The various transportation and handling factors that might have bearing on this type of loss have been analyzed and their relationship established.

The field research covered 18 months in Iowa, South Dakota, Nebraska, Kansas, Colorado, and Texas. Six regional grain marketing cooperatives--referred to in this report as cooperatives A,D,G,H,N, and T--made available a sample of rail shipments from 107 affiliated elevators. This sample covered a period of from 1 to 3 years, depending on availability of shipping records. Most shipments were made in 1961 and 1962. About 35 percent of all shipments made by these elevators during the study period were included in the sample. The sampling rate on shipments at individual

elevators ranged from 10 percent to 100 percent, depending on volumes shipped. In addition to the data obtained from existing records, 700 railroad box cars offered to the elevators by rail carriers were inspected in order to appraise their condition.

RAIL

Discussion of losses in this report will be confined to weight losses as determined by a comparison of weight at origin and weight at destination.

Losses by Type of Grain

In table 1, the loss per car is shown on the basis of the various types of grain shipped by the cooperating elevators. On the basis of all classes of grain, the loss was 558 pounds per car if we distribute total loss over 13,611 sample cars shipped, and 923 pounds per car if the total loss is distributed only over those cars in which shortages occurred.

The first method of showing per car loss provides a means of balancing short cars against cars that arrive at destination either with no change in weight or over weight, and reflects what a given shipper might expect his loss experience to be on all shipments made. The second method, by distributing the total loss among short cars only, indicates rather clearly the degree of seriousness of loss experience on short cars.

A higher percentage of cars loaded with rye and barley were short than of cars carrying other grains. Whether one chooses to consider the loss per car on the total cars shipped or on the loss-cars-only basis, it is apparent from table 1 that all grains handled are subject to loss and that in each case the loss is of sufficient magnitude to be of concern to the shipper.

Losses Related to Total Volume Shipped

Another way to look at these losses is in the light of the total volume in the sample shipments made by the elevators in the study. In table 2, we see that the total volume of the 13,611 shipments was nearly 1.5 billion pounds, or 744,000 tons, and the loss due to shortage at destination was nearly 7.6 million pounds, or 3,800 tons--about 0.5 percent of the total volume based on all sample car shipments and 0.8 percent of total volume based on short cars only.

Table 1.--Shortage per car at destination, by commodity, 107 elevators

Commodity	Elevators shipping	Cars sampled	Percentage of sample cars short	Loss per car	
				All cars	Loss cars only
	---- Number ---		Percent	-----Pounds-----	
Corn	79	4,830	61	657	1,079
Wheat	66	4,589	62	512	827
Soybeans	44	1,745	47	357	767
Sorghums	42	1,655	66	528	793
Oats	47	562	64	672	1,048
Barley	29	139	81	888	1,102
Rye	18	89	73	712	975
Flax	2	2	50	2,830	5,660
All grains	107	13,611	60.5	558	923

Table 2.--Losses as a percentage of total volume of 13,611 rail shipments of various grains, 107 elevators

Commodity	Total volume of all sample shipments	Loss	Percentage loss	
			All shipments	Shipments with losses only
	1,000 pounds	1,000 pounds	Percent	
Corn	533,350	3,150	0.59	0.97
Wheat	518,165	2,342	0.45	0.73
Soybeans	183,791	616	0.33	0.71
Sorghum	180,444	889	0.49	0.74
Oats	48,500	400	0.82	1.29
Barley	14,587	138	0.94	1.17
Rye	9,305	53	0.57	0.79
Flax	202	6	2.97	5.71
All grains	1,488,344	7,594	0.51	0.81

These figures are significant. The shipper might consider them as making it necessary to figure on a discount of one-half of 1 percent, on every car he ships. If we think of the total number of cars of grain shipped in this country in any given year, we can see that the loss becomes one of some magnitude.

Railroad tariffs provide that the carrier is allowed a weight loss or "shrink" of one-eighth of 1 percent on the origin weight without any penalty. In other words, using the weight of an average car of wheat shipped in 1961, 112,940 pounds, 141 pounds loss must be allowed by the shipper. He can make no claim to the carrier for this loss.

It should be emphasized that the loss of an amount under 141 pounds is still a loss to the shipper and should be so regarded when totaling losses for any period of operation. The fact that no claim can be made against the carrier is not a factor in deriving losses; it is a factor only in deriving recoverable losses.

Table 3 shows the weight of an average car of various grains and the amount of loss for which no claim can be made to the railroad.

Table 3.--Average car weight of various grains with weight of loss not claimable, 1961

Commodity	Origin weight of average car[1]	Amount of loss not claimable for average car[2]
	Pounds	Pounds
Corn	110,412	138
Wheat	112,934	141
Soybeans	107,859	135
Sorghums	109,041	136
Oats	86,265	108
Barley	104,800	131
Rye	104,800	131
Flax	99,592	124

[1] Origin weight of car obtained from Freight Commodity Statistics, Class I, Railroads in the United States, year ending Dec. 31, 1961.

[2] One-eighth of 1 percent of origin weight.

Losses by Regional Cooperatives

In a number of instances, a local elevator will be affiliated with more than one regional cooperative association. In some cases, it may belong to as many as three regionals. The local elevators of regional associations A and T were not affiliated with any other regionals, but there were a number of dual or triple

affiliations among elevators identified with the other four regionals cooperating in this study. The majority of the triple affiliations were elevators that belonged to regionals D, H, and N.

There were 107 local elevators affiliated with 6 regional cooperatives that supplied data for this study. In table 4, elevators with dual or triple affiliations have been included in the tabulation for each regional with which they were affiliated. Thus, the number of elevators listed in column 2 (number of elevators shipping) totals more than 107.

The loss experience of the regionals as shown in table 4 is rather uniform except for associations A and T, which happen to be the two whose elevators had exclusive affiliation.

There are certain regulations laid down by the Interstate Commerce Commission covering the filing of claims for loss which must be observed by the shipper. While these may be regarded as bothersome by some shippers, they are prescribed for the protection of both shipper and carrier and they are not so complicated as to defeat the purpose of fair and equitable treatment of shippers suffering loss and damage.

These claims can be filed by the individual shipper directly, or the shipper may designate an agent to handle the claims for him. All of the regional associations involved in this study offer a claim service for their affiliated local elevators. This means that the local can turn over all the information to the traffic department of the regional, which will then prepare the necessary forms and present the claim to the carrier. None of the regionals make any charge for this service. Unfortunately, many locals do not avail themselves of this opportunity to recover their transportation losses.

Another practice is for an elevator to turn over the claims to special "claim services" or "claim agents" who prepare the forms and handle the claim with the carrier involved. In such a case, a charge is made for handling the claim--usually a percentage of the amount for which the claim is settled. We found that about half of the elevators that indicated they did file claims were using claim agents or claim services. The charge was usually from 25 percent to 35 percent of the settlement.

Table 5 shows the claim activity by the six regional associations and the relationship of this activity to losses in 1961. The significant thing about this information is that 52 percent of the local elevators in the study did not file claims, and these elevators had losses that amounted to 41 percent of total losses incurred. It should be noted that those elevators tabulated as filing claims varied widely as to the extent to which claims were filed. Very few filed for every loss on which there was a recoverable amount. Many filed only on those

Table 4.--Loss per car due to shortage at destination, by regional cooperative[1]

Regional cooperatives	Number of elevators shipping	Total cars sampled	Percentage of sample cars short	Average loss per car	
				All cars	Loss cars only
	Number	Number	Percent	Pounds	Pounds
A	12	581	64	771	1,214
D	10	1,243	49	459	942
G	51	6,493	56	562	1,006
H	25	3,602	58	469	812
N	24	3,621	63	540	861
T	16	2,517	67	448	665

[1] Elevators affiliated with more than one regional association are included in the tabulation for each regional with which affiliated. Thus some elevators and cars sampled may appear opposite more than one regional.

Table 5.--Claim activity and relation to losses by 6 regional associations, 1961

Regional cooperative	Percentage of local elevators not filing claims	Percentage of sample shipments	Percentage of sample loss shipments
	Percent		
A	58	41	50
D	50	41	25
G	51	37	32
H	48	45	42
N	46	45	44
T	62	60	63
Average	52	44	43

losses in which the shortage was in excess of a given weight--usually 500 pounds. Entirely too many filed only where losses were very high or where the cars had been reported as leaking, derailed, or otherwise damaged en route.

Filing a claim is of immediate benefit to the shipper in that he has an opportunity to recover his loss in whole or in part. There is also an important secondary benefit. The carrier is made conscious of the deficiencies of its service in a very effective way. From its revenues it must deduct a penalty for loss and damage. When these deductions from revenue become frequent or reach high monetary proportions, carriers become concerned and seek to reduce or eliminate them by improving the quality of equipment and service.

It must be remembered that unless a claim is filed, the carrier may very well be unaware of its deficiencies. Perhaps no single action by shippers can do more to help reduce losses directly and indirectly than the orderly filing and prosecution of justifiable claims.

Relationship of Weighing and Loading Methods to Loss

The various types of scales and hoppers used for loading cars by participating elevators in this study have been grouped into

Table 6--Relationship of losses to loading method used, 107 elevators

Loading method (scales)	Number of elevators using	Total sample shipments	Percentage of sample shipments short	Average loss per sample car	
				All shipments	short cars only
	Number		Percent	Pounds	
Less than 10-bu., automatic	8	746	64	597	937
10-bu., automatic	39	4,253	49	492	1,011
11-24 bu., automatic	10	1,653	67	639	959
25-bu., automatic	26	4,122	64	595	931
Carload scale	7	1,235	76	485	639
Extra big, automatic	1	295	77	348	453
Truck scale, and truck scale plus 10-25 bu. auto.	4	458	62	580	932
10-60 bu., nonautomatic	4	200	64	984	1,537
Miscellaneous (mixed)	5	440	57	443	773
Unknown	3	189	54	1,173	2,153

several categories according to size or type and have been compared as to frequency of use, volume of cars so loaded, and the record of short or loss shipments made (table 6). The 10-bushel and 25-bushel automatic hopper scales were the most widely used. They were in use at about 60 percent of the elevators and accounted for about the same percentage of total cars shipped. Scales also used were 4-bushel, 8-bushel, 15-bushel, 18-bushel, and 20-bushel automatic hopper scales and one or two of much larger capacity.

On the basis of data in table 6, it is difficult to say that any important overall relationship exists between loading method and loss. It should be noted that nonautomatic hoppers were used by four elevators, and the loss or short cars shipped by these four had a much higher per car loss than any other identified loading method, regardless of whether loss is computed on all cars shipped or on short cars only. The carload scales and the one extra large automatic hopper had lower loss per car, although the percentage of total cars shipped that turned up short was highest of all. This means that while larger units for loading are not completely efficient, they nonetheless appear to have a higher degree of efficiency than the smaller capacity scales. The error in each instance was small where the large unit was employed.

An important fact about various loading devices is that any one of them can be used with reasonable assurance of minimizing loss if kept clean and in proper working order. Where this is not the case, it is possible that the origin weight is not a true weight--it may be over or it may be short. If shippers are to exercise control over losses, it is important that they maintain their scales properly because only then can they properly substantiate claims when a car does arrive short at destination.

The growth in use of so-called "official weights" is doing a great deal to bring about more careful weighing. Where these weights are used, the scales have to be clean and accurate. The fact that no loss can accrue to the shipper insofar as shortage is concerned makes others more conscious of the advantage to be gained by using the same care that is required for establishing official weights.

The Problem of Grain Doors

Ever since grain began to move in railroad boxcars, the problem of effectively sealing the door of the car to prevent leakage in transit has been a major concern of shippers. For many years, the doorway was closed by wood platforms or a series of wood cross pieces. There were two major shortcomings: (1) The wood doors were heavy and hard to handle, and (2) they had to be returned to the originating carrier after the car was unloaded. In addition, there was frequent warping and misfitting, which allowed grain to leak out. Various experiments were tried with doors of other types over the years, but none of the substitutes proved practical enough to be adopted by the carriers.

In the last several years, however, a door has been perfected which has been almost universally adopted for use in sealing doorways of railroad box cars. These doors are of heavy paper composition reinforced with steel

Standard boxcar being loaded at the elevator of the Farmers Union Cooperative Marketing Association in Kansas City. Note the paper grain door.

strapping. They are light and easy to handle and are intended for a single movement, thus obviating the need of salvage and return to carrier. Properly installed and given correct treatment during loading, inspection, and unloading, they form an effective means of sealing the car and protecting the grain from leakage.

The major problem with the paper door is that in applying it to the car it is necessary to drive many nails into the car's doorposts. After these posts have had paper doors installed a number of times, the posts reach a condition where the nails will not hold. The condition is further aggravated by the method of unloading at mechanical car dumps, where a ram pushes the door open. This force literally tears the door from the posts, causing additional damage to the posts to which the door is secured. It is apparent that much of the leakage that occurs in cars sealed with paper doors is caused by trying to fit the door to "get by" without the time and expense needed to repair or replace the door posts.

During the course of this study, some complaints were heard which indicated that inspection practices en route caused leakage when cars were equipped with paper doors. It was claimed that inspectors were jamming the probes through the doors to obtain the samples rather than procuring the samples from over the tops of the doors. Obviously, if a hole is made in the door, grain will leak out. However, workers on this study observed many inspections and checked many used doors, and this potential loss appeared to be greatly exaggerated. At no time was an inspector seen to jam the probe through the door, and the number of used doors exhibiting holes which might have been made with a probe was negligible.

Recently, a limited number of railroads have returned to using wood doors. Usually, they are furnishing wood doors for all shipments which will terminate on their own line (thus minimizing the "return problem") and paper doors for shipments to be unloaded at points located on the lines of other carriers. A few of the cooperating elevators in this study were on lines of carriers furnishing wood doors, which enabled us to make some general observations as to loss relationships between the two kinds of doors.

Table 7 shows the number of elevators using various kinds of doors, the number of cars shipped, and the loss per car. Those using

Table 7.--Relationship of grain losses to type of door used in railroad cars, 107 elevators

Type of grain door	Number of elevators using	Total of sample cars	Percentage of sample cars short	Average loss per sample car	
				All cars	Short cars only
	Number	Number	Percent	Pounds	Pounds
Paper					
Brand A	40	5,150	67	474	710
Brand B	32	3,926	57	344	602
Brand C	3	106	34	471	1,387
Brands A and B	3	408	66	221	333
Unidentified	4	465	55	407	745
Total	82	10,055	62	410	660
Various paper and wood	12	1,705	64	365	567
Wood	12	1,813	47	185	392
Unknown	1	38	89	178	199

paper doors have been divided into separate groups, depending on the brand of paper door used. Additional groups provide for a limited number of cases where more than one brand was used from time to time and for four elevators that were using paper doors but were unable to identify the brand.

Records of loss did not permit relating the amount of loss to the door itself. However, as noted later in this report, the doorway is one of the major areas for grain leakage in rail boxcars.

Observations made during the study indicate that any of the paper doors can be effective in reducing losses if properly applied and used. Shippers and carriers alike must realize that, if they use paper doors, doorposts must be solid and kept that way if the doors are to be properly installed. While this is basically a carrier responsibility, shippers should use judgment in coopering and should either make minor repairs or reject cars needing repairs in order to prevent loss. Some consideration might also be given to the problem of removal of doors at destination to overcome damage caused by rams in automatic car dumps.

Workman changing the direction of the loading spout to a standard boxcar equipped with paper doors which may become damaged or torn causing loss of grain.

Traffic Patterns and Losses on Specific Movements

In table 8, the movement of the various sample shipments included in this study is shown on a state-of-origin basis. There were 25 terminating States including the 6 originating States, all of which terminated shipments originating within their own borders. Some 50 different combinations of origin and destination occurred.

About two-thirds of all shipments were intrastate. Iowa, Nebraska, and Texas had particularly large percentages of intrastate shipments. In the other three States of origin, shipments destined outside the State predominated. Intrastate shipments were 44 percent of the total for Kansas, 41 percent for Colorado, and only 5 percent for South Dakota.

The average loss per car for all sample shipments shown in table 8 ranged from a low of 42 pounds on South Dakota intrastate wheat shipments to a high of 6,566 pounds on the one interstate shipment of barley from Iowa.

Mileage figures for various shipments are not shown; however, an analysis was made of those shipments which moved in excess of 1,000 miles. This was to determine if long-distance shipments were associated with higher losses. There were a total of 271 such individual shipments, of which 183 showed loss. While the overall loss for all sample shipments (13,611) was 558 pounds per car for all cars shipped, the long-distance shipments averaged 1,415 per car. On the basis of loss cars only, the figures were 923 pounds for all loss cars (8,231 cars) and 2,096 pounds for the 183 long-distance loss cars. It should be noted, however, that most of the long-distance shipments were corn (67 percent) and these constituted almost all of the high-loss long-distance shipments.

Table 8.--Intrastate and interstate movements of 13,611 sample grain shipments by State of origin, type of grain, and amount of loss, 6 regional grain marketing cooperatives

Type of grain	South Dakota				Colorado				Kansas				Nebraska			
	Intrastate		Interstate		Intrastate		Interstate		Intrastate		Interstate		Intrastate		Interstate	
	Total sample cars	Average loss per sample car	Total sample cars	Average loss per sample car	Total sample cars	Average loss per sample car	Total sample cars	Average loss per sample car	Total sample cars	Average loss per sample car	Total sample cars	Average loss per sample car	Total sample cars	Average loss per sample car	Total sample cars	Average loss per sample car
	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds
Corn			42	1,559	9	447					13	2,585	363	719	218	528
Wheat	33	42	487	840	204	667	313	495	432	976	556	503	998	402	287	310
Soybeans													10	383	7	169
Sorghums			17	117	4	604			46	2,584	33	577	57	514	170	373
Oats			95	1,096									11	2,518		
Barley	6	1,460	24	839	5	1,264	2	930	38	721	27	842	2	670	5	722
Rye	1	360	79	759			1	640					1	--	3	280
Total cars	40		744		222		316		516		629		1,442		690	

Type of grain	Texas				Iowa				Total			
	Intrastate		Interstate		Intrastate		Interstate		Intrastate		Interstate	
	Total sample cars	Average loss per sample car	Total sample cars	Average loss per sample car	Total sample cars	Average loss per sample car	Total sample cars	Average loss per sample car	Total sample cars	Average loss per sample car	Total sample cars	Average loss per sample car
	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds
Corn					2,571	644	1,614	720	2,943	653	1,887	729
Wheat	1,172	417	4	147	11	1,665	85	503	2,850	515	1,732	564
Soybeans					1,378	331	350	513	1,388	331	357	506
Sorghums	1,248	466	58	547	1	110	26	1,058	1,356	540	304	473
Oats	1	870			409	531	47	351	421	584	142	849
Barley	32	766					1	6,566	83	823	59	931
Rye	3	194					1	1,040	5	188	84	744
Total cars	2,456		62		4,371		2,124		9,046		4,565	

Losses by Originating Railroads

The 107 affiliated elevators of the 6 regional grain cooperatives participating in this study were each served by 1 of 9 railroads. In table 9, the number of elevators served by each carrier, the number of cars originated, and the percentage of cars reported short at destination are shown. Five of the lines served about 90 percent of the participating elevators and handled about 91 percent of the total cars shipped.

Table 9.--Percentage of sample cars short, by originating railroad, 107 elevators

Railroad	Elevators served	Total sample cars originated	Percentage of sample cars short
A	10	1,675	66
B	22	2,740	59
C	3	177	51
D	14	1,423	61
E	32	3,711	57
F	18	2,802	61
G	1	38	89
H	5	698	61
J	2	347	69
All lines	107	13,611	61

The percentage of sample cars shipped that were short at destination varied from 51 percent to 89 percent for all carriers and from 57 percent to 66 percent among the five principal railroads.

It is difficult to establish any valid association between losses and originating carriers, because of the multiplicity of other factors involved and because so frequently the originating carrier handles the shipment for only a part of the total movement. However, the data do indicate that differences in losses exist and that perhaps some carriers may do a better job than others--probably by furnishing better cars.

Whether the specific location of an elevator on the line of a given carrier has any relationship to loss was also explored. The reason for this was the general feeling in the trade that elevators located on branch lines, particularly minor branches, received poorer service and poorer equipment, which would result in higher loss rates.

The results of this analysis are shown in table 10. There was very little difference in the percentage of cars short whether the elevator was located on main or on branch railroad lines.

Table 10.--Percentage of sample cars short, by elevator location on railroad, 107 elevators

Type of line	Elevators	Percentage of sample cars short
	Number	Percent
Main line	56	62
Principal branch	24	57
Minor branch	27	61

Because of the interchange operation of railroad cars, the cars that a road furnishes a shipper often belong to another carrier. The diversity of ownership is illustrated by table 11, which shows the ownership on a geographical basis of all the cars in which the shipments in this study moved. The roads in the Central Western Region and the Northwestern Regions provided the majority of the cars, since the elevators were served by carriers assigned to these regions. However, it is interesting to note that over 25 percent of the cars belonged to carriers whose lines are east of the Mississippi River. In all, 94 different railroads owned the cars that were identified. Sixty-two cars were not identified on the shipping records of the cooperating elevators, although they were no doubt identified on the bills of lading at time of shipment.

Cars of another carrier operating on the line of a given railroad are referred to as "foreign" cars. In this study, 65 percent of all the cars were "foreign" insofar as the railroad serving the particular elevators was concerned. Thus, a car of Pennsylvania Railroad ownership furnished by the Milwaukee Railroad to an elevator on its line in Iowa

Table 11.--Source of sample railroad cars loaded by 107 elevators

Geographical region assigned carrier by ICC	Railroads furnishing cars	Sample cars	Percentage of all sample cars
	--------Number--------		Percent
Central Western	9	4,848	36
Northwestern	14	4,340	32
Southern	19	1,148	8
Great Lakes	14	1,104	8
Central Eastern	19	769	6
Southwestern	6	671	5
Pocahontas	5	340	3
Canadian Railroads	3	182	1
New England	5	147	1
Unidentified	-	62	(1)

[1] Less than 1 percent.

would be a foreign car. The question arose during the study as to the possibility that shortages or losses might be greater on shipments made in foreign cars than on shipments in cars owned by the carrier serving the elevator.

Analysis of study data indicated that the difference in losses between foreign cars and cars of local carrier ownership was not appreciable. Of the foreign cars, 62 percent showed losses; 59 percent of the on-line cars were short. The percentage of foreign cars furnished by the nine carriers serving the cooperating elevators ranged from 47 percent to 95 percent. Looking at the loss record of the carriers (that is, the percentage of cars short at destination on the basis of originating carrier), no positive correlation was established.

Some Other Loss Factors

In addition to the many possible loss relationships that have been discussed thus far, there are at least two more which must be considered. One of these is the physical condition of the cars furnished by the carrier. The other has to do with the human element involved in all phases of transportation and handling incident to marketing.

Condition of Equipment

Railroads are supposed to furnish cars to shippers which are in such physical condition that lading can be transported safely without loss or damage. In the case of cars furnished for the movement of grain, this means tight cars--cars that have sound floors, sidewalls, bulkheads, and roof so that leakage cannot occur or the elements outside adversely affect the commodity. Additionally, the doorposts should be in good condition so that the doorway can be properly sealed with the installation of either paper or wood grain doors. If a car is sound or tight, the doorway properly sealed, and lading weighed accurately when loaded, the car under normal conditions should not be appreciably short at destination.

It is common knowledge, however, that many boxcars furnished grain shippers fail to meet the standards outlined above. This is particularly true during the busy harvest season when cars are likely to be in short supply. At such a time, the need for cars is so urgent that the carriers are forced to return an empty for immediate reloading without making any or all of the needed repairs to put the car in proper condition for the subsequent movement. The feeling is that it is better to furnish a car that is not up to standard rather than

furnish no car at all or furnish the car on a delayed basis. Delay could result in grain piling up on the ground because of lack of storage space in the elevator.

During the course of this study, 700 boxcars furnished the cooperators for the transportation of grain were carefully checked as to physical condition. The inspection was made on a four-part basis that considered the car from the standpoint of its four component parts affecting loss in transportation--floors, ends (bulkheads), sidewalls (including doorposts), and roof. In each of these categories, defects were classified according to their most common form on a generally descriptive basis.

Of the 700 cars inspected, only about 15 percent were found to be completely sound and free from loss-associated defects. However, many of the cars with defects were usable provided some repairs were made by the elevator before loading.

Table 12 gives the results of these inspections. It can be seen that most defects were in sidewalls, these defects occurring half again as often as those in ends and twice as often as those in floors. The major problem with sidewalls was doorposts, which in over 40 percent of the instances of defective sidewalls were missing or so badly damaged as to preclude proper application of grain doors.

The most common defects in all components of the car were holes, cracks, or both. Obviously, these are especially important in grain transportation. Perhaps the most important bit of data in table 12 is the indication that 52 percent of the cars were defective in two or more areas.

Of the cooperating elevators, 28 kept a record of cars that were given some sort of

Table 12.--Location of defects in 700 inspected rail cars, and extent and character of defects[1]

Location of defect	Percentage of cars with defect	Character of defect	Percentage of defects of this character	Location of defect	Percentage of cars with defect	Character of defect	Percentage of defects of this character
	Percent		Percent		Percent		Percent
Floor	34			Sidewall	76		
		Holes	36			Bad or missing doorposts	41
		Cracks	54			Missing boards	13
		Weak or rotted	10			Holes, cracks	21
						Broken boards	25
End	45			Roof	11		
		Holes, cracks	33			Cracks, holes, bad seams	56
		Part missing	30			Loose liner	25
		Battered	15			Part of liner missing	19
		Loose liner	5				
		No liner or improvised liner	17				

	Percent
[1] Cars with 1 defective part	48
" " 2 " parts	40
" " 3 " "	11
" " 4 " "	1

repairs by the elevator staff before being loaded. These records covered a period of from 3 to 9 months. The record showed the location of the repairs made within the car and gave an estimate of the time required to make them. A summary of the record of location of repairs is shown in table 13. Note that 24 percent of the cars on which repairs were made had repairs at more than one place in the car.

Table 13.--Location of repairs made on rail cars by 28 local elevators

Location of repairs	Percentage of total repairs reported
	Percent
Floors	48
Doorposts	25
Sidewalls	21
Ends or bulkheads	6
More than 1 location	24

The major item reported was floor repair. This is understandable because (1) a hole or large crack in the floor is obviously going to leak grain and virtually demands repair, and (2) such holes or cracks can usually be repaired fairly easily and without too much cost or labor with scrap materials. It is safe to assume that the repairs made to doorposts were equally mandatory, as it is virtually impossible to install paper doors properly without either replacing, overhauling, or installing new posts.

Applying the lowest possible minimum wage rates to the time spent in making repairs, labor cost was estimated to be at least 60 cents per car. No data were obtained on the cost of material used; in most cases it was scrap material around the elevator or material furnished by the carrier. At any rate, in calculating losses in transporting grain, shippers should include expenditures made in repairing cars, whether the cost is for materials or labor involved, because it is a cost they should not have to bear. It is one that should, and legally does, belong to the carrier. There is also an added cost for cleaning a car, which also must be considered a shipper loss.

Virtually all loss of grain due to leaking, as well as the loss or costs incurred in repairing defects, could be eliminated if the shipper rejected all unsuitable cars offered by the carrier. Realistically, however, this is impossible for most shippers. We have already mentioned the urgency that prevails during the harvest season because of lack of storage and shortage of cars. But there are other times that refusal to accept a defective car is impossible or undesirable, usually because of the need to ship promptly in order to meet customer requirements.

A shipper located on a branch or a line that gives infrequent service has an especially difficult decision. If he rejects a car, it may be several days, or even longer, before the carrier can supply another car. In all circumstances, it must be presumed that other economic considerations outweigh the possibility of losses associated with defective equipment, so that the shipper "makes the car do" and either loads it "as is" or repairs it to the best of his ability.

The 28 cooperating elevators that provided information on repairs also supplied a record of cars rejected over a period of several months. These records are summarized in table 14. The reasons for rejection rather closely parallel defects found in the cars inspected by the researchers on this study and the reports of repairs made by elevators. The doorpost problem is highlighted again, and we can assume that defective doorposts were the major cause of rejection because it is so difficult, as well as time consuming and expensive, for the local shipper to repair them. In fact, often the doorposts are missing and the adjacent sidewalls have already been literally "chewed up." Again, 24 percent of the cars rejected were refused because of defects in more than 1 location within the car.

Table 14.--Reason for and extent of rejection of cars by 28 elevators

Reason for rejection	Percentage of total reasons given
	Percent
Missing, broken, or unsatisfactory doorposts	42
Defective floors (holes, cracks, weak spots)	31
Defective ends or bulkheads	10
Defective sidewalls (other than doorposts)	9
Car dirty or contaminated	7
Defective roof	1
More than one reason	24

While it is clear that many shippers are using unsuitable cars--cars that could be rejected--it should be remembered that the carriers are not always blameworthy. The exigencies of the situation sometimes make the offering of such cars inevitable--the carriers simply offer the best they have. Then too, the carrier may not be aware of the car's condition, because it has just been unloaded and is placed for immediate reloading. Here the shipper has a responsibility to alert the carrier either by rejecting the car or advising the agent of the car's condition, making it clear that he is "making it do." In this way the carrier is fully informed and can take steps to improve the quality of the equipment offered.

The Human Element

We have considered many different factors that could have a relationship to loss. In some instances, a direct relationship appears rather certain while in others the relationship is either inconclusive or tenuous. Actually, the most important finding from the research done is the indication that the part people play in transportation and handling makes losses greater or smaller.

The research indicates that 10-bushel hoppers can be handled as efficiently as those much larger; paper doors can do as effective a job in sealing a car as wooden ones; elevators on minor branch lines of railroads do not necessarily have to suffer higher losses than those on the main line; foreign cars can be just as sound as on-line cars; big shippers and small shippers alike can control losses; and small capacity elevators appear to do as good a job of controlling losses as large ones.

These findings suggest that, for a particular elevator, the decisions management makes, the way employees carry out their duties, the care with which handling and weighing equipment is maintained, and the way in which cars are prepared and loaded for shipment contribute to minimizing losses in grain handling and transportation by rail.

BARGE

Seven regional grain cooperatives that use water transportation furnished records for this study on 777 barges of grain that moved on the principal rivers of the Mississippi system in 1962. All barge shipments of these cooperatives on which records of origin and destination weights were shown were included in the study.

The barges carried a total of 31 million bushels of corn, wheat, soybeans, and oats during 1962. Movement patterns, which include both domestic and export shipments for each commodity, are found in tables 15 through 18.

Conditions Causing Loss

Loss and damage to grain during transportation by barge may occur in several ways. Equipment may be defective; handling of grain into and out of the barge may be inefficient;

Barges being loaded with grain at the barge loading facility of the Farmers Grain Dealers Association of Iowa, McGregor, Iowa.

Table 15.--Corn movements to all destinations, 7 cooperatives, 1962

From	To	Barges	Volume	Volume
		Number	Bushels	Tons
Upper Mississippi	New Orleans[1]	124	5,263,327	147,373
Illinois River	New Orleans	105	4,571,982	128,016
Illinois River	Tennessee River[2]	94	3,986,228	111,610
Upper Mississippi	Tennessee River	37	1,723,637	48,262
Illinois River	Gulf Ports[3]	9	399,750	11,193
Illinois River	Memphis	9	411,748	11,530
Upper Mississippi	Memphis	7	324,890	9,098
Upper Mississippi	Gulf Ports	7	322,763	9,038
Illinois River	Baton Rouge	7	289,362	8,103
Total		399	17,293,687	484,223

[1] Including Westwego and Destrahan, La.
[2] Including Decatur and Guntersville, Ala. and Chattanooga, Tenn.
[3] Including Pascagoula and Vicksburg, Miss., and Mobile, Ala.

Table 16.--Wheat movements to all destinations, 7 cooperatives, 1962

From	To	Barges	Volume	Volume
		Number	Bushels	Tons
Missouri River	New Orleans [1]	117	3,570,580	107,117
Missouri River	Baton Rouge	64	2,057,313	61,719
Illinois River	New Orleans [1]	29	1,251,466	37,544
Upper Mississippi	Illinois River	17	768,905	23,067
Missouri River	Chicago	17	584,331	17,530
Upper Mississippi	New Orleans [1]	7	282,717	8,482
Upper Mississippi	Baton Rouge	6	258,100	7,883
Illinois River	Memphis	1	45,000	1,350
Total		258	8,818,412	264,692

[1] Including Westwego and Destrahan, La.

Table 17.--Soybean movements to all destinations, 7 cooperatives, 1962

From	To	Barges	Volume	Volume
		Number	Bushels	Tons
Illinois River	New Orleans [1]	31	1,263,108	37,894
Missouri River	New Orleans [1]	17	602,408	18,072
Illinois River	Tennessee River [2]	16	632,419	18,972
Upper Mississippi	New Orleans [1]	14	603,109	18,094
Upper Mississippi	Tennessee River	11	461,047	13,831
Illinois River	Memphis	4	155,679	4,670
Upper Mississippi	Mobile	1	39,512	1,185
Total		94	3,757,282	112,718

[1] Including Westwego and Destrahan, La.
[2] Including Decatur and Guntersville, Ala. and Chattanooga, Tenn.

Table 18.--Oats movements to all destinations, 7 cooperatives, 1962

From	To	Barges	Volume	Volume
		Number	Bushels	Tons
Upper Mississippi	Baton Rouge	9	411,124	6,578
Upper Mississippi	Louisville	7	247,949	3,967
Illinois River	Memphis	4	230,598	3,690
Illinois River	Tennessee River [1]	5	207,494	3,321
Upper Mississippi	Tennessee River [1]	1	58,092	929
Total		26	1,155,257	18,485

[1] Including Decatur, Ala., and Chattanooga, Tenn.

grain may spoil because of infestation of insects; or the quality may deteriorate because of improper loading or climatic conditions.

The following data were obtained for each of the barge shipments studied: (1) Date and place of origin, (2) weight at origin, (3) size and type of barge, (4) condition of barge, (5) date of arrival at destination, (6) weight at destination, (7) temperature and moisture samples, (8) information pertinent to losses by collision or sinking.

Losses by Type of Grain

Although loss and damage may result from a number of different factors, the only tangible record found was of differences between origin and destination weights.

Losses suffered through "shrink" in barge weights are borne by shippers or receivers of grain because the barge lines do not accept liability for shortages of this nature. Contrast this situation with that of the railroads, which are liable for loss resulting from a shortage of weight exceeding one-eighth of 1 percent of the total weight of the car.

Losses due to the differences in origin and destination weights are shown in tables 19 through 25. Net losses in bushels and losses as percentages of origin weights are tabulated for each commodity movement, for movements on each river, and for movements into each of the principal ports. The average load and loss per barge are also shown in the tables.

Wheat movements (table 19) covering almost 9 million bushels had a loss ratio of less than one-fourth of 1 percent of origin weight. Two movements showed a net overage.

Soybeans had the highest percentage of loss--over one-half of 1 percent of origin weight. The percentage losses of corn and oats were about the same, and approximated the average for all grains--about one-third of 1 percent.

During part of the year of this analysis, the lock at Wheeler Dam on the Tennessee River was not in use. Grain was transferred over and around the dam by means of marine legs and trucks. However, the movement on this river did not show the highest percentage of loss.

Table 19.--Loss as a percentage of origin weights of wheat, 7 cooperatives, 1962

From	To	Volume	Barges	Net loss	
		Bushels	Number	Bushels	Percent
Missouri River	New Orleans[1]	3,570,580	117	10,923	0.30
Missouri River	Baton Rouge	2,057,313	64	8,114	.39
Illinois River	New Orleans[1]	1,251,466	29	+708	--
Upper Mississippi River	Chicago	768,905	17	401	.05
Missouri River	Chicago	584,331	17	+140	--
Upper Mississippi River	New Orleans[1]	282,717	7	773	.27
Upper Mississippi River	Baton Rouge	258,100	6	530	.20
Illinois River	Memphis	45,000	1	24	.05
Total		8,818,412	258	19,917	
Average		34,180		77	.23

[1] Including Westwego and Destrahan, La.

Table 20.--Loss as a percentage of origin weights of corn, 7 cooperatives, 1962

From	To	Volume	Barges	Net loss	
		Bushels	Number	Bushels	Percent
Upper Mississippi River	New Orleans [1]	5,263,327	124	21,974	.42
Illinois River	New Orleans	4,571,982	105	13,825	.30
Illinois River	Tennessee River [2]	3,986,228	94	8,318	.21
Upper Mississippi River	Tennessee River	1,723,637	37	6,149	.36
Illinois River	Memphis	411,748	9	793	.19
Illinois River	Gulf Ports [3]	399,750	9	575	.14
Upper Mississippi River	Gulf Ports	322,763	7	1,245	.38
Upper Mississippi River	Memphis	324,890	7	1,077	.33
Illinois River	Baton Rouge	289,362	7	869	.30
Total		17,293,687	399	54,825	
Average		43,342		137	.32

[1] Including Westwego and Destrahan, La.
[2] Including Decatur and Guntersville, Ala., and, Chattanooga, Tenn.
[3] Including Pascagoula, and Vicksburg, Miss., and Mobile, Ala.

Table 21.--Loss as a percentage of origin weight of soybeans, 7 cooperatives, 1962

From	To	Volume	Barges	Net loss	
		Bushels	Number	Bushels	Percent
Illinois River	New Orleans	1,263,108	31	9,911	0.78
Missouri River	New Orleans	602,408	17	985	.16
Illinois River	Tennessee River [1]	632,419	16	4,269	.67
Upper Mississippi River	Tennessee River	461,047	11	2,199	.47
Upper Mississippi River	New Orleans [2]	603,109	14	1,836	.30
Illinois River	Memphis	155,679	4	1,166	.74
Upper Mississippi River	Gulf Ports [3]	39,512	1	157	.39
Total		3,757,282	94	20,523	
Average		39,971		218	.55

[1] Including Decatur and Guntersville, Ala., and Chattanooga, Tenn.
[2] Including Westwego and Destrahan, La.
[3] Including Pascagoula, Miss., and Mobile, Ala.

Table 22.--Loss as a percentage of origin weight of oats, 7 cooperatives, 1962

From	To	Volume	Barges	Net loss	
		Bushels	Number	Bushels	Percent
Upper Mississippi River	Baton Rouge	411,124	9	667	0.16
Upper Mississippi River	Louisville	247,949	7	944	.38
Illinois River	Memphis	230,598	4	1,222	.53
Illinois River	Tennessee River[1]	207,494	5	621	.30
Upper Mississippi River	Tennessee River[1]	58,092	1	110	.19
Total		1,155,257	26	3,564	
Average		44,433		137	.31

[1] Including Decatur and Guntersville, Ala., and Chattanooga, Tenn.

Table 23.--Loss as a percentage of origin weights, all grains, 7 cooperatives, 1962

Grain	Volume	Barges	Net loss	
	Bushels	Number	Bushels	Percent
Wheat	8,818,412	258	19,922	0.23
Corn	17,293,687	399	54,825	.32
Soybeans	3,757,282	94	20,523	.55
Oats	1,155,257	26	3,564	.31
Total	31,024,638	777	98,834	
Average				.32

Table 24.--Loss on movements by river, all grains, 7 cooperatives, 1962

River	Volume	Barges	Net loss	
	Bushels	Number	Bushels	Percent
Mississippi	7,505,542	175	28,834	0.38
Illinois to Mississippi	8,618,693	199	27,107	.31
Missouri to Mississippi	6,230,301	198	20,022	.32
Mississippi to Tennessee	2,242,776	49	8,458	.38
Mississippi to Ohio	247,949	7	944	.38
Illinois to Tennessee	4,826,141	115	13,208	.27
Mississippi to Illinois	768,905	17	401	.05
Missouri to Illinois	584,331	17	+140	--
Total	31,024,638	777	98,834	
Average				.32

Table 25.--Loss on movements into principal ports, all grain, 7 cooperatives, 1962

Ports	Volume	Barges	Net loss	
	Bushels	Number	Bushels	Percent
New Orleans	17,408,697	444	59,519	0.34
Baton Rouge	3,015,899	86	10,180	.34
Tennessee River	7,068,917	164	21,650	.31
Gulf Ports	762,025	17	1,993	.26
Memphis	1,167,915	25	4,287	.37
Chicago	1,353,236	34	261	.02
Louisville	247,949	7	944	.38
Total	31,024,638	777	98,834	
Average				.32

Amount of Loss

When measured in terms of commodity, river, and port movements, losses in weights showed little in the way of specific patterns. The loss ratios were so small that differences of 0.05 to 0.10 percent were insignificant. No one route or port appeared to have an advantage over the others, at least enough to justify isolating it for further study.

The average loads carried by barges in this study amounted to 34,180 bushels for wheat, 43,342 bushels for corn, 39,971 bushels for soybeans, and 44,433 bushels for oats. Average losses per bargeload were 137 bushels for oats, 77 bushels for wheat, 137 bushels for corn, and 218 bushels for soybeans. Whether or not cargo insurance is carried by shippers, such shortages do represent an economic loss, and attention should be directed toward their elimination, if possible.

Factors examined in order to determine their possible contribution to loss and damage were:

(1) Infestation of insects in the barge, presence of storage fungi if grain was stored in the barge for long periods, and the effect of changes in moisture and temperature.
(2) Facilities and equipment used in handling grain.
(3) Other factors such as weighing techniques and the possibility of pilferage.

The MV Omaha positions another barge "up river" at the Fairfax Missouri River dock of the Union Cooperative Marketing Association to await loading. Each barge is loaded with 35,000 to 45,000 bushels of grain, about the same amount as is loaded in 17 railroad boxcars or 45 semitrailer trucks.

Infestation, Storage Fungi, Changes in Moisture and Temperature

For the barge movements covered, no evidence of insect infestation was reported. Both

carriers and shippers used a variety of techniques for cleaning barges; some used their own employees whereas others hired the service at flat charges per barge. It seems obvious that careful attention to the condition of the barge before loading was a primary reason for the absence of infestation as a major problem.

Movements by water carrier are slow relative to other modes of transportation, averaging only 6 to 8 miles per hour. From Missouri River points, 18 to 26 days were used to move wheat to New Orleans. From upper Mississippi River points to Gulf Ports, the movement of corn took 24 days. Corn shipments from Illinois River Ports to the Tennessee River took 22 days.

Storage fungi, which under certain climatic conditions could cause deterioration in grain stored over fairly long periods, were not found to be a direct cause of damage in barge shipments. However, losses were incurred due to grade changes made at terminal points because of high moisture content.

Such losses would not show up in the weights unless the moisture content was high enough to warrant drying the grain before weighing and sale.[2] The problem arises when shipments are loaded in relatively cool temperatures and then moved to areas of higher temperatures and humidity. Terminal officials suggested that grain with a moisture content of over 15 percent would probably suffer grade losses at destination.

Complaints were also made at destination terminals regarding the methods of measuring moisture content of grain in barges; they were primarily concentrated on the lack of standardization in sampling techniques. Moisture content is usually determined by a few samples, which are assumed to provide an accurate measure of the contents of the barge. However, the samples may not show the range prevailing from place to place. Since grain is bought and sold on the basis of average moisture content, it is essential in grading to know the highest moisture content of the grain. If the moisture content ranges from 13-15 percent or above, differences may be of great importance because of the effect on grade changes and amount of spoilage.[3] Some authorities were of the opinion that losses could have resulted from relatively high moisture content and the necessity for drying with resultant weight losses. Such opinions are not supported by the facts.

Another view of the Fairfax dock from atop a tow boat. The barge is loaded in approximately 2 1/2 hours.

[2] Examples were found in barges of corn on the Tennessee and lower Mississippi Rivers. The grain had been graded as #2 at origin, arrived at destination 14 days later and was graded as #4. The damage, estimated at 8 percent of the load, was caused principally by the fact that the upper third of the barge was heated.

[3] A summary of the findings of Dr. Clyde Christianson, University of Minnesota, on the relationship of moisture content to spoilage of grain is found in the Co-op Grain Quarterly, National Federation of Grain Cooperatives, St. Paul, Minn., summer 1962.

Facilities and Equipment Used in Handling Grain

In most instances, the physical location of elevators along the rivers necessitated a complex network of conveyers to move the grain into and out of the barge. High-speed belts requiring little or no labor conveyed the grain rapidly and efficiently from and to the elevators, and whatever losses occurred by spillage appeared to be negligible.

Other Factors

In the discussions of losses with shippers and port officials, the location, inspection, and maintenance of scales appeared to be extremely significant. Normally, scales are located in the elevators where the grain is weighed before loading or after discharging and before it is placed in storage bins. The closer the scales are to the docks, the fewer opportunities arise for shrink in weight. Weighing grain some distance from loading points and then trucking it to docks without further weighing is considered an inefficient practice, since the possibility of losses generally increases in proportion to the number of times the grain is handled. Not only is a weight problem involved; the possibility of pilferage also must be considered.

The importance of having official weights on scales inspected and maintained periodically (every 3 months) was mentioned time and time again in these discussions. Some authorities believed lack of care in weighing and lack of maintenance of scales were factors responsible for part of the 94,834 bushels of grain lost on the movements.

Pilferage may also have accounted for some of the losses, but would have involved relatively small amounts.

This study indicates that the losses by barge occurred in handling or from inefficient scales or weighing techniques. No significant evidence was found to support the thesis that the loss or damage occurred from defective equipment, poor loading or discharging facilities, or infestation of grain by insects.

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Other Publications Available

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